CHAPTER 3: REVIEW OF LITERATURE OF SCIENTIFIC INVESTIGATIONS

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INTRODUCTION

Present chapter deals with the review of scientific literature which is relevant to the present study. The whole chapter is therefore divided into four sub-sections: 1) Eletro-photonic Imaging and related researches; 2) Mobile phone induced electro-magnetic field and related researches; 3) Functional near-infrared spectroscopy and related researches and 4) Meditation and related researches.

3.1. EPI (ELECTRO PHOTONIC IMAGING)

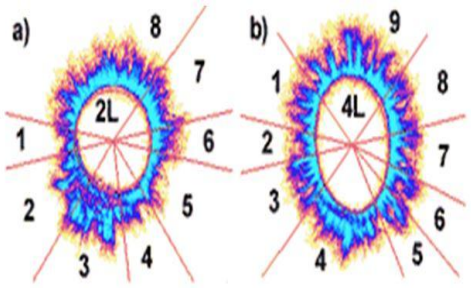
In the history of Science, development of a new instrument has always resulted in new understanding of scientific reality. Without the instruments like Microscope, telescope, X-rays, camera, laser, and computer, the modern science is powerless. In 1996, Prof Konstantin Korotkov developed a range of instruments for stimulation, recording and processing of Electro photonic images and called his technique Gas DischargeVisualization (GDV; Figure 2).

Figure 2: Electro Photonic Imaging (EPI) or Gas DischargeVisualization (GDV)

Device

One of the most significant applications of the EPI technique today is assisting health professionals in quick and accurate assessment of human state and in comparing effectiveness of various therapies (KirlianResearch.com).

EPI is a breakthrough technology that measures human energy fields that surround the body. By measuring the energy fields, we may be able to see patterns at the subtle level that could show up as physical problems later (Konstantin Korotkov, 2004). It seems possible to determine not only what happens in the human body, but also where it happens by examining specific sectors of the electro-photonic glow. Bio-electrography has the potential to serve as an extremely powerful and comprehensive medical diagnostics tool, capable of showing malfunctions of the body and mind long before any physical symptoms become evident. By utilising the potential of bio-electrography it should be possible to take preventive measures, rather than wait until emergency treatments and surgery are required (Bio-field Sciences, 2014).



Clinically verified sectors of the Kirlian glow around human fingertips seem to contain information about relative bio-energetic performance of various organs.

Figure 3: Glow around human fingertips

The EPI technique is based on so-called Kirlian effect, named after Semion Kirlian and his wife, who first recorded and studied stimulated electro-photonic images around various objects (Figure 3). Electro Photonic Imaging (EPI.), previously known as Gas

DischargeVisualization. (GDV) diagnostic system is an advanced form of the basic Kirlian method of Prof Korotkov. It involves stimulating and recording 40 ms of the electro-photonic glow around all ten fingertips one at a time (KirlianResearch.com). This is a relatively new technology in the United States that first arrived from Russia fewer than five years ago (Korotkov K et al; 2012).

3.1.1. EPI (Electro Photonic Imaging) and its components

The GDV Camera Pro system includes:

- Hardware:

  GDV Camera Pro

  Test-object for system calibration and reproducibility tests

  GDV triggering system

- Software

  Windows required

  GDV Capture - interactive capturing of Kirlian (GDV) images. GDV-capture enables capturing an automatic series of images or a video of the aura at many frames per second.

Figure 4: EPI Images of Ten Fingertips

GDV Energy Field - processing & interpretation of Kirlian images of 10 human fingertips (Figure 4). Glow in certain sectors around human fingers correlates with performance of particular organs and systems of the human body based on acupuncture theory. GDV-Aura enables to determine the degree of harmony in functioning of internal organs and systems and enables medical practitioners to spot the weakest aspects of the human body/mind system within seconds (Figure 5).

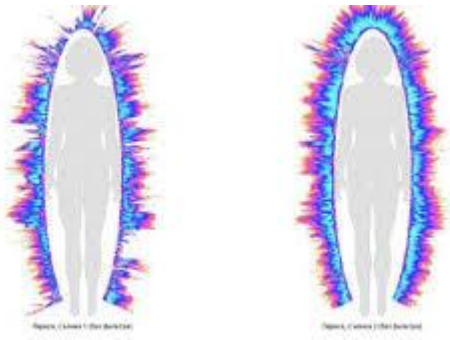


Figure 5: Energy Fields of Different Organs in the Human Body

GDV Diagram - comparative performance analysis of systems and organs of the human body on the basis of GDV images of 10 fingertips. GDV-Diagram normalizes the captured data so that health of any individual can be compared to health of thousands of people in the same age group.

3.1.2. Mechanism of action of Electro Photonic Imaging

Finger pads are placed one at a time into the special camera box (Figure 6). The fingers are the termination points of the 12 main meridians of the body. The emitted light from each finger is captured, and those images are analysed with a sophisticated mathematical tool known as fractal dimensionality. In real time, data measurements of the person's chakra energy patterns and glands/organs energy patterns are collected and then displayed as fields in and around human figure drawings (Samuel A Berne, 2014).

Figure 6: Figure showing the process of EPI data collection

An intense field of electricity is created around an object by an EPI camera (10 kV, 1024 Hz in 0.5 seconds). This field of electricity produces a gassy discharge of light around the object, also called a Kirlian picture, which is then transferred to a computer with built-in video capabilities and the necessary accompanying software (Figure 7). Because there is no photo-paper involved in the process, there's also no need for a darkroom as images are saved via the computer's hard drive (Korotkov, K et al; 2009). Further, this is an entirely safe procedure since the current flowing through the fingers is very low, in microamperes.

Figure 7: Figure showing electrical energy field around the finger

By measuring the energy fields, Electrophotonic Imaging can analyse in great detail chronic and systemic physical problems, as well as psychological and mental problems. Examination of the energy fields may allow patients to learn if some of their patterns hint at possible physical problems later (Figure 8). Conventional, molecular-level medicine treats disease

with no connection of body and mind. A patient's body is treated like a machine. Often drugs keep the mind-body-spirit disconnected (Korotkov, K., Orlov, D., & Madappa, K; 2008).

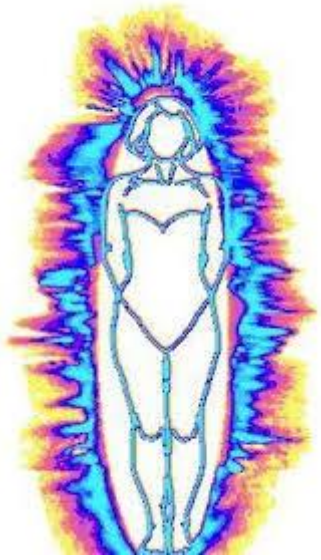


Figure 8: EPI Field of The Body Reconstructed from Fingertips Energy

Once the problems are located, they can more easily be overcome. That includes such important long-term health issues as the negative effects of stress, blocked energy and buildup of toxins in your body. But only when the areas of energy disturbance are located, it is possible to formulate an effective treatment plan. Even better, Electro Photonic Imaging can be used again and again to see if the therapies are working. The software and equipment EPC/GDV-complex is a convenient and easy-to-use device which easily allows examining patients with various pathologies and, therefore, offers a wide range of applications. The EPI method has shown itself to be very fast (i.e., it is an “express-method” for studying states of the human organism). The review has revealed that EPI method can be implemented as an express method for assessment of treatment procedure effectiveness, evaluating emotional and physical conditions of people, and in many other fields (Korotkov K. et al; 2010).

3.1.3. Normal Range of EPI Components and their significance

To properly characterize the EPI-gram the following indices are used:

EPI background area, averaged intensity, energy, normalized area, integral area coefficient, emission coefficient, form coefficient, fractality coefficient along with dispersions of all mentioned parameters.

The EPI parameters of interest in this study are presented here.

- **Integral area (IA)** {Normal Range is -0.6 to +1}: It indicates the following-

1. Level of adaptation of organism to inner (psycho-physiological) and external (stress, food, ecology) influences;
2. Character of metabolism;
3. Depends on quantity of electrons in avalanches, ionizing air gap;
4. The more electrons, the higher level of metabolic rate;
5. Area of glow is in proportion to quantity of electrons

- **Entropy (E)** {Normal Range is 1.5 to 2}: It indicates the following-

  It is a measure of chaos or disruption in regulation of physiological functions; level of deregulation; level of tolerance to external influences.

Increase or Decrease of these values from the given range is found in ill health or having issues in related organs. (Korotkov, 2002).

3.1.4. Studies on Application of EPI in medicine

The EPI technique is a nonintrusive biometric tool with the ability to identify deviations from healthy function at early stages, and in real time. By means of electrophotonic emissions from the fingertips placed on the surface of an impulse analyser, it gives values pertaining to the functional state of most organs and organ systems; it thus claims to assess peoples' overall

physiological and psycho-emotional status (Kostyuk et al; 2011). In medicine, comparison of electro-photonic images (EPI) before and after surgery, cancer treatment, energy healing, physiotherapy etc. is used to monitor patients' progress. Findings have demonstrated its potential to identify deviation from normal states during early etiological stages of disease development, as well as to monitor transitions from diseased states to healthy states i.e. normal function (Kostyuk, N., Cole et al; 2011).

3.1.4.1. Arterial Hypertension

To study the potential of EPI analysis for detecting patients with arterial hypertension of different degrees of severity. Participants were 603 patients, aged from 18 to 83 (265 males 338 females). All patients were classified into groups according to degree and stage of Arterial Hypertension and possible risk of Cardio Vascular complications. In the course of study the following EPI parameters were analysed: Image Area, Normalized Area, Intensity, Spectrum Width, Brightness and Fractality.

The study resulted in the calculation of discriminative functions for detecting patients with various stages of Arterial Hypertension and the risk of Cardio Vascular complications. The number of diagnostic parameters increased in accordance with the degree of Arterial Hypertension manifestations from 8 to 22 and specificity and sensitivity of the obtained functions made up from 70% to 80%. It was concluded that Electrophotonic technique can be allowed for population screening due to its high accuracy (Alexandrova et al; 2004).

3.1.4.2. Bronchial Asthma

An analysis of the data which examines 247 patients with Bronchial Asthma (BA) compared to 56 healthy people is presented to demonstrate a practical medical application of EPI. . The effectiveness, ability to estimate appropriate dynamics and parameters of this disease and

assessment of various therapies' effectiveness as measured by EPI are reviewed. This study also insures uniformity in data gathering and reproducibility for EPI techniques, based upon clinical experiences and empirical observations. The EPI-grams of a practically healthy individual with normal basal metabolism which is in harmony with environment is characterized by a uniform fluorescent corona of the EPI diagram. The EPI-gram of a patient with BA attack is distinguished by an 'outburst' of glow in the respiratory zone of the fifth finger (Alexandrova et al; 2003).

3.1.4.3. Diabetes mellitus

A study carried out by Bhawna Sharma at S-VYASA was aimed to analyze changes in the *prāṇamayakośa* due to type 2 Diabetes Mellitus. It showed how population norms may change according to various associated demographic variables. The study was performed without using a filter while taking EPI. The sample size was far less than in Korotkov's Russian studies, and was for a limited population.

3.1.5. EPI as marker of Pathology

3.1.5.1 Autism

The aim of this study was to test Autistic children, siblings and their parents using a biometric device based on EPI technique in order to assess their psycho-emotional and physiological functional state based on the activity of the Autonomic Nervous System. EPI was used to evaluate some specific features associated with Autism spectrum disorder and also to analyse difference in individual values of parents of Autistic children versus parents of normal children. All compared groups have shown significant difference on both psycho-emotional (images without filter) (yes, the above statement of Bhavana's study is not correct)

and psychological (images with filter) levels. Differences between Autistic children and the control group based on psycho-emotional level was more significant compared to the others.

It was concluded that the activity of Sympathetic Autonomic Nervous System is significantly altered in children with Autism. The method based on EPI is a promising step in autism research that may lead to the creation of a disease profile (Kostyuk et al; 2010).

3.1.5.2. Oncology

To explore the potential of EPI for oncology practice, a study was performed to assess the EPI's prognostic potential, and to monitor patients' state during complex oncological treatments. Subjects diagnosed with third stage cancer were selected: 109 with lung cancer, 140 with breast cancer, a control group of 44 healthy people, and 54 women with various non-oncological conditions. EPI measures were taken before treatment, and 2-6 weeks after complex treatments including surgery, chemotherapy and radiation. Statistically significant differences between EPI parameters of oncology patients and non-oncology groups were found. After treatment, statistical trends of EPI parameters were towards values for the healthy population (Gagua PO et al; 2004).

3.2 MPEMF (Mobile Phone Induced Electro-magnetic Field)

Anytime power is on, cell phones emit electromagnetic radiation, known as mobile phone electromagnetic radiation (MPEMF) – even in stand-by mode and regardless of whether they are carried on belts, or in pockets or purses - which expose all areas of the body to potentially harmful ELF radiation (Moulder, 1999).

3.2.1. MPEMF Effect on Human Physiology

The incredible technological innovations are empowering man like never before and making his life easy. However, they also have been found to exert a negative impact on the quality of life. One such example is the dramatically increasing number of mobile phone users worldwide. It is raising significant concerns about potential damage due to radiation exposure. As mobile phones are used close to the brain, the brain tissue could get damaged or affected. Numerous studies have investigated the effects of exposure to radiofrequency electromagnetic waves from the mobile phone base stations on nervous system and behaviours. The dangers of electromagnetic radiation are becoming increasingly evident and are now being associated with many diseases. Some say it is scientifically impossible for Electromagnetic Radiation (EMR) to affect us, but there is mounting evidence to prove cell damage due to EMR. During noon time, adolescents with a measured exposure in the highest quartile during morning hours reported a statistically significant higher intensity of headache. During bedtime, adolescents with a measured exposure in the highest quartile during afternoon hours reported a statistically significant higher intensity of irritation, while in the evening, children reported a statistically significant higher intensity of concentration problems (Ozdemir, F., & Kargi, A;2011).

3.2.1.1.Mobile Phone Radiation might alter Protein Expression in Human skin

This is the pilot human volunteer study, using proteomics approach, to examine whether a local exposure of human skin to MPEMF will cause changes in protein expression in living people. Small area of forearm's skin in 10 female volunteers was exposed to MPEMF and punch biopsies were collected from exposed and non exposed areas of skin. Proteins extracted from biopsies were extracted and analysed using PDQuest software. Analysis identified 8 proteins that were statistically significantly affected. Two of the proteins were present in all 10 volunteers. This study confirms that proteomics screening approach can identify protein targets of MPEMF in human volunteers (AnuKarinen et al; 2008).

3.2.1.2. Mobile phones and Head Tumours

A close examination of the protocols and results from all case control and cohort studies pooled along with meta analysis on head tumours for mobile phone users was carried out. Blind Protocols free from errors, bias and financial conditioning factors, give positive results that reveal a cause – effect relationship between long term mobile phone use or latency and statistically significant increase of ipsilateral head tumour risk, with biological plausibility. In these studies, a statistically significant increase in the risk of ipsilateral head tumours is quite common after more than 10 years of Mobile phone use or latency. The meta analysis examining only data on ipsilateral tumours in subjects using Mobile phone since or for at least 10 years show large and statistically increase in the risk of ipsilateral brain gliomas and acoustic neuromas. The analysis of the literature studies shows an almost doubling of the risk of head tumours induced by long term mobile phone use or latency (Angelo G Levis et al, 2011).

Prof Leszczynski of Finland's radiation and nuclear safety ascendancy found that, at the maximum permissible limit for mobile radiation, one protein, in particular HSP 27 was

affected. HSP 27 plays a critical role in the integrity of the blood-brain barrier. A publication titled "Public health implicative insinuations of wireless technologies" cites that Lennart Hardell found age to be a consequential factor. The report reiterated the finding that the utilization of cell phones before age 20 incremented the jeopardy of brain tumors by 5.2, compared to 1.4 for all ages.(Sage & Carpenter, 2009) A review by Hardell et al. concluded that current mobile phones are not safe for long-term exposure.(Hardell, Carlberg, & Mild, 2009)

The effect of mobile phone radiation on human health is a subject of interest and universal study as a result of the enormous increase in mobile phone utilization throughout the world. As of November 2011, there were more than 6 billion subscriptions ecumenical (Edewor & Imhonopi, 2013). In a study conducted in 1994, 16 million Americans subscribed to cellular phone accommodations. Today, more than 110 million Americans are subscribers. Some experts predict that ecumenical subscribership will reach 1.2 billion people by 2005. The incidence of brain cancer has incremented 25% since 1973, according to the National Cancer Institute. Each year, 185,000 Americans will be diagnosed with a primary or metastatic brain tumor, according to the National Brain Tumor Substructure (Gaudin, 2001)

A study was conducted to identify health symptoms associated with exposure to electromagnetic fields among university students at Rafsanjan University of Medical Sciences, Iran. The result found symptoms of headache (53.5%), Fatigue (35.6%), difficulties in concentration (32.5%), vertigo/dizziness (30.4%), attention disorders (28.8%), Nervousness (28.1%), palpitation (14.7%), low back pain (14.3%), myalgia (12.4%) and tinnitus (9.9%) etc. A consequential similarity was found between cordless phone use and difficulties in concentration and attention disorders (Mortazavi, Ahmadi, & Shariati, 2007).

A descriptive study was conducted to investigate the association of mobile phones utilization with fatigue, headache, dizziness, tension and sleep disturbance and to subsequently provide health and social awareness.

Among a total of 437 subjects (55% male and 39.9% female) here invited have been utilizing mobile phones. The result showed that utilization of mobile phones led to health hazards like headache (21.6%), fatigue (3%) and dizziness 2.4%) It also concluded that utilization of mobile phones for long time is a perilous factor for health hazards (Al-Khlaiwi & Meo, 2004). Research by Polish scientists show a high cancer death rate among soldiers exposed to microwave radiation at levels commensurable to that emitted by mobile phones when in utilization. This is believed to be the first paramount study which shows a link between humans, microwave radiation and cancer (Maisch, 2001). The rapid increase in mobile phone use in puerile people has engendered concern about possible health effects of exposure to radiofrequency (RF) and profoundly low frequency (ELF) electromagnetic fields (EMF). The study, which aims to include approximately 1,000 brain tumor cases aged 10–24 years and two individually matched controls for each case, follows a prevalent protocol and builds upon the methodological experience of the INTERPHONE study. MOBI-Kids is feasible and will engender results that will contribute to the construal of potential brain tumor risks associated with utilization of mobile phones and other wireless communications technologies among adolescent people. (Sadetzki et al., 2014). In 2007, Dr. Lennart Hardell, from Örebro University in Sweden, reviewed published epidemiological papers (2 cohort studies and 16 case-control studies) and found that Cell phone users had an incremented risk of malignant gliomas. Cell phone use was linked to a higher rate of acoustic neuromas. Tumors are more liable to occur on the side of the head where the cell handset is used. One hour of cell phone use per day significantly increases tumor risk after ten years of use or more (Hardell, Carlberg, & Söderqvist, 2007). In 2009, a meta-analysis of 23 studies on mobile phone use

and tumor risk found that "there is possible evidence" that mobile phone use causes an incremented risk of tumors (Myung, Ju, & McDonnell, 2009).

3.2.1.3. MPEMF (Mobile Phone Electro Magnetic Radiation) Effect on children and adolescents

Adverse health effects from exposure to electric, magnetic and electromagnetic fields (EMF), and especially the question of whether there exists a special vulnerability in children, have been much discussed topics during the last two decades. Static fields produce health effects only in very rare and exceptional circumstances at extremely high field intensities. As for low-frequency EMF, results of epidemiological research on childhood leukaemia prompted the International Agency for Research on Cancer (IARC) in 2001 to classify these fields as "possibly carcinogenic to humans" (Otto, M., & von Mühlendahl, K. E; 2007).

Children are potentially at greater risk than adults for developing brain cancer from cell phones. Their nervous systems are still developing and therefore more vulnerable to factors that may cause cancer. Their heads are smaller than those of adults and therefore have a greater proportional exposure to the radiofrequency radiation emitted by cell phones. They may also accumulate more years of cell phone exposure than adults. However, data so far obtained from studies on children with cancer do not support this hypothesis.(Kheifets, L., Repacholi, M., et al; 2005).

3.2.1.4. Association between mobile phone use and inattention

A cross sectional study was carried out to investigate possible associations between Mobile Phone use and Inattention in adolescents. 7720 middle school students were studied. After adjusting for confounders, inattention in adolescents was found to be significantly associated

with Mobile Phone ownership, the time spent on Mobile Phone per day, position of Mobile Phone during the day, and its mode at night. Students who spent more than an hour (60 min) per day on their Mobile Phones exhibited more inattentiveness than others in the group.

This study on Chinese adolescents demonstrates links between Mobile Phone use and Inattention. Decreasing Mobile Phone use to less than an hour per day may help adolescents to stay focussed and centered (Zheng F et al; 2014).

3.2.1.5. Mobile Phone Radiation affects Short Term Memory

This study shows that the Visual Reaction Time (VRT) of University students is affected significantly when they are exposed for 10 minutes to MPEMFs. Also, short term MPEMF exposure leads to changes in reaction time and short term Memory. 60 Elementary school students were subjects in the study. Ages ranged from 8 to 10 yrs. Standardized computer based tests of VRT and Short Term Memory were administered. Subjects were asked to perform preliminary orientation tests along with VRT test. This was the first study to show that the Short Term exposure of school students to Mobile Phone radiations leads to the better performance of their Short Term Memory (Vvahedi MM; 2014).

3.2.1.6. EPI Study of effect of mobile phone use on the human physiology

A Russian study has assessed physiological response to mobile phone use, and possible ways to protect against such effects (Korotkov et al. 2010). Participants were 15 healthy young women aged 20-30 years. EPI energy levels were compared after 5 and 10 minute time periods, first with a switched on mobile phone near the subject's ear and second, with the mobile phone switched off. Measurements were also made with various protective devices attached to the mobile phone in switched on mode. When the mobile phone was On, subjects'

autonomic nervous systems reacted to it, detailed effects seeming to depend on time length of usage, type of phone, and condition of the participant concerned.

3.3. Functional Near Infrared Spectroscopy (fNIRS)

3.3.1.Introduction

fNIRS is a device designed to detect changes in the concentration of oxygenated (oxyHb) and deoxygenated (deoxyHb) haemoglobin molecules in the blood, a method commonly used to assess cerebral activity. Over the last decade, functional near-infrared spectroscopy (fNIRS) has widely extended its applications due to its capacity to quantify oxygenation in blood and organic tissue in a continuous and non invasive manner (Chance & Leigh, 1977; Villringer & Chance, 1997). This technique is an effective, albeit 'indirect', optical neuroimaging method that monitors hemodynamic response to brain activation, on the basis that neural activation and vascular response are tightly coupled, so termed 'neurovascular coupling'. Different studies show that neural activity and hemodynamic response maintain a lineal relationship (Arthurs & Boniface, 2003; Logothetis et al., 2001), suggesting that these changes in hemodynamic response could provide a good marker for assessing neural activity. In neuroscience, functional near-infrared spectroscopy (fNIRS) is used to measure cerebral functions through different chromophore mobilization (oxygenated haemoglobin, deoxygenated haemoglobin and cytochrome c-oxidase) and their timing with concrete events. Due to methodological and theoretical problems associated with cytochrome c-oxidase functioning (Cyt-Ox), current neuroscience studies on cerebral functions only assesses and analyzes oxyHb and deoxyHb mobilizations.

These chromophore mobilizations are directly related to the cerebral blood flow (CBF) associated with an event and the physiological reactions provoked by the brain's functional state (fNIRS measures these reaction in the cerebral cortex). The assessment of these task

related mobilizations performed in light of a base line established by the researcher him/herself. The difference in oxyHb and deoxyHb concentrations at baseline and at task performance determines the location in the cortex of an increase or decrease in CBF. An increase in CBF is associated with cerebral activity, making the temporal and spatial correlation between CBF and task a determinant of cerebral function. This capacity to study cerebral functions, both spatial and temporal, is what gives name to the technique described in this chapter: functional near-infrared spectroscopy (fNIRS). fNIRS has become a valuable neuroimaging technique, novel in its easy application and characterized by its small size, portability, and reliability. Although relatively new to the field of health care, fNIRS use is growing rapidly in clinical settings and research, particularly in work involving higher level cognitive control. fNIRS measures of hemodynamic response have been used in numerous studies to assess cerebral functioning during resting state (Lu et al., 2010) and tasks on motor skills (Leff et al., 2011; Obrig et al., 1996a), vision (Gratton et al., 1995; Herrmann et al., 2008), hearing (Zaramella et al., 2001), speech (Cannestra et al., 2003) social skills (Ruocco et al., 2010), learning (León-Carrión et al., 2010), emotion (León-Carrión, 2006, 2007a, 2007b), and executive functions (Chance et al., 1993; León-Carrion et al., 2008; Nakahachi et al., 2010). fNIRS is a proven medical device for monitoring hemodynamic activity through the intact brain cortex in normal adult subjects, a powerful and original functional neuroimaging technique which charts cerebral functioning in a non-invasive and relatively low-cost manner. The application of fNIRS in cerebral functioning studies has been validated by other neuroimaging techniques, showing that the NIR signal maintains a strong correlation with PET measures of changes in regional cerebral blood flow (rCBF), and the fMRI Blood Oxygen Level Dependent (BOLD) signal (Hock et al., 1997; Huppert et al., 2006; Kleinschmidt et al., 1996; MacIntosh et al., 2003; Toronov, 2001, 2003; Villringer and Chance, 1997). Yet compared to traditional neuroimaging technology, fNIRS is noninvasive,

safe, portable and inexpensive (Gratton, et al. 1995; Strangman, 2002; Totaro et al., 1998; Villringer & Chance, 1997; Wolf, et al., 2002; Zabel & Chute, 2002). Given these characteristics, fNIRS makes it possible for research to be done more ecologically, in clinical and social settings, without the restrictions of more traditional scanners. Furthermore, fNIRS technology is ideal for studies in which subjects may have a more difficult time with traditional neuroimaging techniques, namely children, patients with dementia, etc. The flexibility of fNIRS also makes it ideal for studies involving patients who are in movement (Milla et al., 2001), patients who are bed-ridden (von Pannwitz et al, 1998), and new-borns (Goff et al., 2010).

3.3.2. The Principles of fNIRS

Spectroscopy is based on the study of light signals. Many fields of science use this technique to study the composition of objects, both organic and inorganic. In 1949, Hill and Keynes (1949) reported that nervous system cell activity was associated with changes in the optical properties of light. NIRS has thus far the unique feature of being able to measure intravascular (oxyHb and deoxyHb) (Jöbsis, 1977) and intracellular (cytochrome c-oxidase) (Heekeren et al., 1999) events simultaneously. In the study of cerebral functioning, a ray of light is used near the visible spectrum of light (NIR). More specifically, a light source known as a light-emitting diode (LED), emits a ray of quasi-infrared light at the scalp, half the wave absorbed by the chromophores (oxyHb, deoxyHb and cytochrome c-oxidase) found in the nervous tissue. A photo detector captures the light wave resulting from the interaction with the chromophores following a banana-shaped path back to the surface of the skin (see Fig 9.) (Gratton et al, 1994). The characteristics of this light wave have changed in respect to the original emitted by the LED due to the absorption and dispersion capacity of the nervous tissue and chromophores (Figure 9).

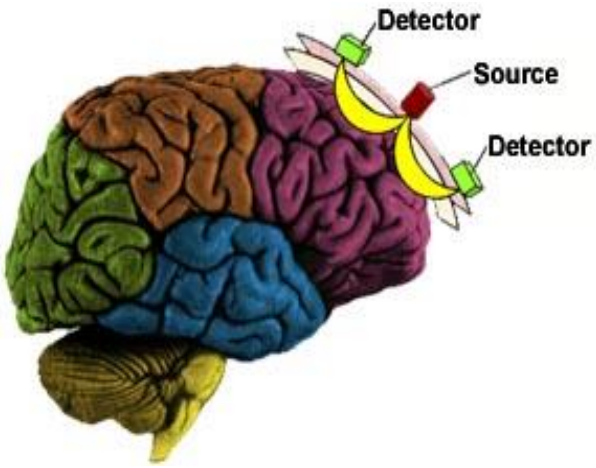


Figure 9. Light from the light source is guided to the head by an optode. A photo-detector will collect the light which leaves the head at a distance of some centimetres. The photons follow a banana-shaped path from light source to detector.

The absorption spectra of light absorbing molecules (chromophores) are used to interpret the attenuated light levels as changes in chromophore concentration. The low absorption capacity of biological tissue (composed mostly of water) is one reason why light waves pierce different extracerebral tissue with hardly any absorption of NIR rays. In contrast, chromophores have characteristic optical properties which absorb rays close to the light. The transparency of the biological tissue, along with the absorption capacity of the diverse chromophores, makes it possible for optic methods to be used to measure hemodynamic responses (Chance, et al. 1998; Villringer and Chance, 1997). The optimal light spectrum for studying cognitive functions ranges between 700-900nm, which could be considered the biological "optical window", framed by chromophore mobilization (Jöbsis, 1977). This optical window lends itself to non-invasive, low-risk methods for studying cerebral processes.

3.3.3. Applications of fNIRS

fNIRS has been approved by the FDA for clinical purposes and can be used simultaneously with other neuroimaging technologies. Studies show that fNIRS is a valid and reliable assessment tool for task-associated oxygenated blood, and while it may be early to define all the applications of this new technology, we believe it promises to find utility far beyond this in clinical practice. There are several types of clinical applications that could benefit from the unique attributes of fNIRS neuroimaging technology (Izzetoglu et al., 2004):

- Populations that may not be able to readily tolerate the confines of an fMRI magnet or be able to remain sufficiently still, e.g., schizophrenics, autistic children, neonates.

- Populations that require the long-term monitoring of cerebral oxygenation, e.g., premature and other high-risk infants.

- Studies that require repeated, low-cost neuroimaging, e.g., treatment studies that image the cortex for efficacy.

- Applications where an fMRI system would be too expensive or cumbersome, e.g., for use in a clinical office.

- Applications that require ecological validity, e.g., working at a computer or in an educational setting.

Furthermore, its current use is widely accepted by the neuroscientific community for studying cerebral functions due to its high level of consistency with findings based on traditional neuroimaging techniques. Like these, it measures neuronal activity indirectly via hemodynamic response. However, fNIRS is the only technique which can measure both extracellular and intracellular activation, with the latter still under development. fNIRS holds great potential for growth and application in clinical and research settings, offering new

possibilities in neuro-imaging techniques and expanding our knowledge about the functional organisation of the brain.

3.3.4. FNIRS Research

Multi-channel near-infrared spectroscopy (NIRS) is a recently developed optical method that allows noninvasive in vivo measurements of changes in the concentration of oxygenated ([oxy-Hb]) and deoxygenated ([deoxy-Hb]) hemoglobin in brain issue. Since Jobsis (Jobsis, 1997) first found that useful information in brain could be obtained using light and detected from the scalp, NIRS has been well established as a functional imaging method recently. The technique is based on the principle that near-infrared light (wavelengths from 650 to 900 nm) penetrates biological tissues and is mainly absorbed by the two chromophores [oxy-Hb] and [deoxy-Hb], which have different light absorption spectra in the near-infrared range, then the changes in chromophore concentrations can be detected by measuring changes of the amount of reflected near-infrared light in the skull. Cortical activation found by NIRS suggested an increase in [oxy-Hb] and a corresponding decrease in [deoxy-Hb] (Hoshi & Tamura,1993,1997; Obrig et al, 2000).

Compared with other functional neuroimaging methodologies, such as PET, SPECT and fMRI, NIRS is especially suitable for studying psychiatric disorders, due to the following reasons: low susceptibility to movement artifacts, less restrictive and compact, lower cost. Accordingly, multi-channel NIRS has been employed to study the brain functions in many psychiatric disorders, such as schizophrenia, depression, bipolar disorder and post-traumatic stress disorder (Kameyama et al, 2006; Matsuo et al, 2005; Matsuo et al, 2003 , Suto et al, 2004; Takizawa et al, 2008). However, nearly all these studies used verbal fluency test (VFT) as an activation task and only a limited number of reports using the TOL task to assess planning ability by means of multi-channel NIRS. Table 1 provides the review of the similar

studies which have used different cognitive tasks in healthy individuals as well as in different psychiatric conditions.

3.3.4.1. Effects of MPEMF on Cerebral blood flow using Functional Near Infrared Spectroscopy (fNIRS)

A recent study on 29 volunteers tested for acute exposure to MPEMF generated by the MP operating in the Global System for Mobile communication (GSM), 900 MHz, on cerebral blood flow. All participants were exposed to two experimental sessions: a sham exposure session and a real exposure session in a cross-over double-blind study in which a mobile phone was positioned on the left side of the head. In one session, the mobile phone was operated without RF radiation (sham phone) and in the other study it was operated with RF radiation (real phone) for 20 min. Trans-cranial Doppler Sonography was used to measure middle cerebral artery blood flow velocity. Pulsatility index and resistance index were evaluated. Results showed that there were no significant changes detected in middle cerebral arteries during RF exposure (Spichtig, Scholkmann, Chin, Lehmann, & Wolf, 2012).

Another study was conducted on 15 young participants exposed to short term GSM MP radiation to assess cerebral blood flow changes using positron emission tomography. Whole brain images were acquired 12 times, 3 for each condition, in a counter-balanced order. The results provided no evidence for acute effects of short term MP radiation on cerebral blood flow (Kwon et al., 2012).

A previous positron emission tomography (PET) study found increased CBF in the prefrontal cortex after 30 minute exposure to a 900-MHz GSM signal (Huber et al., 2002, 2005). Another similar PET study showed decreased CBF in the temporal cortex after a continuous 51 minutes exposure to a 902-MHz GSM signal (Aalto et al., 2006). Brain energy metabolism study done using PET on 13 young male subjects exposed to a pulse modulated

902.4 MHz GSM for 33 minutes while performing a simple visual vigilance task showed that relative cerebral metabolic rate of glucose was significantly reduced in the temporo-parietal junction and anterior temporal lobe of the right hemisphere ipsilateral to the exposure (Kwon et al, 2011).

Functional Near Infrared Spectroscopic (fNIRS) studies on short term effects (occurring within 80 seconds) of intermittent Universal Mobile Telecommunications System electromagnetic fields (UMTS-EMF) on blood circulation in the human brain was assessed and no significant changes were observed. In another study, also using fNIRS, local cerebral blood flow (CBF) on short term exposure to MPEMF was measured in 26 boys, aged 14-15 years. Temperatures were also measured from both ear canals, and skin temperatures at several sites of the head, trunk and extremities. It was found that, local CBF and ear canal temperature did not change and autonomic nervous system was not interfered (Lindholm et al., 2011). Notwithstanding the results, the studies showed the utility of fNIRS for EMF related research. fNIRS which measures changes in oxy, de-oxy and total haemoglobin concentrations, (which reflect changes in cerebral activity, perfusion, and/or oxygenation) has an advantage over other similar functional neuroimaging methodologies, such as PET, SPECT, and fMRI due to its high temporal resolution, low susceptibility to movement artifacts, lesser restrictions, compact and lower cost. Present study aims at identifying the mechanism as well as a reliable exposure protocol in order to gain more insights into possible hemodynamic changes due to high-frequency EMF exposure through assessing its impact on brain blood flow changes using Functional Near Infrared Spectroscopy (fNIRS).

Few PET studies provided inconsistent results on rCBF changes between the two groups, and further studies are needed to draw clear conclusions (Preece et al, 2005). Compared to previous studies using PET, NIRS provides a much higher time resolution, which allowed investigating the short term effects efficiently, noninvasively, without the use of radioactive

tracers and with high sensitivity (Wolf et al, 2006). Very few studies have assessed the effect of MP EMF on cognitive functions in children and adolescent population (Preece at al, 2005; Haarala et al, 2004). To the best of our knowledge no study has been performed using functional neuroimaging techniques to assess rCBF changes in children and adolescents. No fNIRS study has measured changes in temporal-parietal areas which are supposed to be more affected by MP EMF than dorso-lateral pre-frontal cortices (DLPFCs). Table 1 provides details of fNIRS studies in healthy individuals and psychiatric patients.

Table 1: Review of fNIRS Studies in healthy individuals and psychiatric patients

STUDIES	PARTICIPANTS	INSTRUMENTS	RESULTS
Boecker et al. (2007)	16 healthy adults	Stop-signal task modified (stop-change)	– activation of L and R PFC, with rCBF L < R
Ehlis et al. (2007)	12 schizophrenic Patients and 12 matched CTR	Verbal fluency: phonological and semantic	– significant frontal HbO increase in healthy controls, L > R; – functional deficits in frontal HbO activation in schizophrenics
Ehlis et al. (2005)	10 healthy adults	Stroop task	– significant L frontal (inferior) HbO (and total Hb) increase during interference task
Herrmann et al. (2005)	9 healthy adults	Go/No-Go	- significant L and R frontal (inferior) HbO increase and HHb decrease during inhibition phase
Jayacar et al. (2005)	17 healthy adults	Verbal fluency: phonological (C, F, L) and semantic (animals	– signifcant L and R frontal HbO increase during word generation;
Kwee and	60 healthy adults	WAIS-III subtests:	– significant age-

Nakada (2003)		picture completion, matrix reasoning, picture arrangement	related decrease in DLPFC activation
Schecklmann et al. (2007)	12 alcohol dependent patients	Verbal fluency: phonological and semantic	– decrease in activation (lower HbO) and the localization more restricted to inferior frontal areas in alcohol dependent patients
Schoroeter, Zysset, Kruggel, et al. (2003)	14 healthy young adults	Stroop task (modified)	– significant PFC (lateral) activation related to interference (young and elderly); – age-related decrease in rCBF PFC (lateral) during functional activation
Watanabe and Kato (2004)	62 schizophrenia patientsand 31 healthy adults	Verbal fluency (phonological) letter-number span	– smaller increase in frontal Hbo in schizophrenic patients
Weber et al. (2005)	11 ADHD boys and 9 healthy CTR	TMT (Trail Making Test) (modified)	– increase L PFC oxygenation in controls; – imbalance between HbO and HbR in ADHD
Fallgatter and Strik (1998)	10 healthy adults	WCST	– significant L and R frontal HbO increase, no hemispheric differences
Shibuya-Tayoshi et al. (2007)	41 healthy adults	TMT	– greater PFC increase of HbO during TMT Part B than during Part A

3.4 REVIEW OF SCIENTIFIC LITERATURE ON MEDITATION

Since we introduce a particular meditation technique (OM meditation) in trying to alleviate the effects of MPEMF in young adults in this study, we present a brief overview of relevant meditation studies from this university. Meditation and mental activity have been discussed in the earlier PhD thesis from S-VYASA, Bengaluru, India (Naveen, 2005; Patil, 2007; Pailoor, 2009; Kumar, 2019; Raghvendra, 2012). Meditation follows concentration. It is very difficult to say where concentration ends and meditation begins. In *dhyāna*, all worldly thoughts are shut out from the mind. The mind is filled or saturated with divine thoughts, the divine glory or with the divine presence. Meditation is the continuous flow of thought of one thing, God or Atman. It is keeping up with one idea of God alone, always like the continuous flow of oil from one vessel to another, *tailadhāravat*.

Meditation is the seventh rung or step in the ladder of Ashtanga Yoga of Patanjali.*Yamā* (self-restraint), *niyama* (personal observance), *āsana* (posture), *prāṇāyama* (restraint or regulation of breath), *pratyāhāra* (abstraction or withdrawal of the senses), are all *bahiranga* (external) yoga for the physical body. *Dhāraṇā*(concentration), *dhyāna* (meditation) and *samādhī* (superconscious state or blissful union with the Supreme Self) are the eight steps of Yoga. The last three steps are referred to as *Antarang* (internal) yoga.

The concept of *OM* meditation and its benefits were explained in the earlier PhD thesis titled "Concept of Om meditation and its components (*cañcalatā*, *ekāgratā*, *dhāraṇā*, and*dhyāna*) according to ancient yogic texts and spiritual lore" (Kumar, 2009). The mind is disciplined in the beginning by fixing it on a concrete object or symbol. AUM, the *Praṇavaḥ*, the Omkara is the only symbol of God (*Īśvara*, Brahman), the absolute, described in

Māṇḍukyopaniṣat (Sivananda, 1998). This symbol denotes the all-pervading immortal, indivisible, self-luminous, unchanging Brahman, the Supreme Self.

States of meditation (*cañcalatā, ekāgratā, dhāraṇā,* and *dhyana*) were briefly compiled in another PhD thesis titled "Psychophysiology of meditation, including responses to external stimuli" (Naveen, 2005). Similarly, these four mental states are described in detail in another thesis by Raghvendra, 2012, entitled, "Concept of meditation in traditional yogic texts & spiritual lore" using traditional Indian texts.

3.4.1. Neuro-hemodynamic and cognitive effects of OM chanting

The sound "OM" is believed to bring mental peace and calm. In a recent study (Kumar et al, 2014), the cortical activation associated with listening to sound "OM" in contrast to similar non-meaningful sound (TOM) and listening to a meaningful Hindi word (AAM) has been investigated using functional magnetic resonance imaging (MRI). The results reveal that listening to "OM" sound in contrast to the meaningful Hindi word condition activates areas of bilateral cerebellum, left middle frontal gyrus (dorsolateral middle frontal/BA 9), right precuneus (BA 5) and right supramarginal gyrus (SMG). Listening to "OM" sound in contrast to "non-meaningful" sound condition leads to cortical activation in bilateral middle frontal (BA9), right middle temporal (BA37), right angular gyrus (BA 40), right SMG and right superior middle frontal gyrus (BA 8). The conjunction analysis reveals that the common neural regions activated in listening to "OM" sound during both conditions are middle frontal (left dorsolateral middle frontal cortex) and right SMG. The results correspond to the fact that listening to "OM" sound recruits neural systems implicated in emotional empathy. Another study, used fMRI to assess neuro-hrmodynamic effects of OM chanting 11 healthy volunteers. OM chanting was performed for 30 secs whether O.. was chanted for 5 seconds and MM.. continued for 15 seconds, this was compared with SSS chanting. The

neurohemodynamic correlates of 'OM' chanting indicated limbic deactivation. Authors concluded that, "as similar observations have been recorded with vagus nerve stimulation treatment used in depression and epilepsy, the study findings argues for a potential role of this 'OM' chanting in clinical practice" (Kalyani et al, 2013). Another study found beneficial effects of 10 minutes of daily OM Chanting in enhancing working memory index in 52 children after a month of intervention (Yadav et al, 2013). Traditionally also, OM is considered as a cosmic sound which is subtlest of all energies and the "sound of creation", it removes disorderliness and brings harmony in the system (Mandukya Upanishad). Therfore, present study plans to observe the effects of OM chanting on brain hemodynamics and cognitive performance of children while they are exposed to mobile phone EMF, to understand whether OM chanting exerts any restoring effect.

Table 2: Meditation and Cerebral Blood Flow Changes

Author & Year of Publication	N	Design	Variable studied	Findings
Jevning, Wilson, Smith, Morton (1978)	12	Transcendental Meditation (TM) or ordinary eyes-closed rest-relaxation period	Cardiac output, renal and hepatic blood flows, arterial lactate concentration, and minute volume	Marked declines of renal blood flow, hepatic blood flow, increased cardiac output, decreased arterial lactate, and minute volume were also recorded in the TM-induced rest period.
Jevning, Wallace, Beidebach (1992)	10	Transcendental Meditation (TM)	Cerebral Blood Flow and Cerebrovascular Resistance (CVR)	Increased frontal and occipital CBF in TM determined by the electrical impedance plethysmographic
Jevning R, Anand R, Biedebach M, Fernando G. (1996)	-	Transcendental meditation (TM).	Cerebralblood flow (CBF) measured using electrical impedance plethysmographic methodology known as rheoencephalography (REG),	High correlation between increased CBF and decreased cerebrovascular resistance (CVR) during TM, suggesting that a contributing vascular mechanism to the increased CBF may be decreased CVR.
Lou HC, Kjaer TW, Friberg L, Wildschiodtz G, Holm S, Nowak M. (1999)	9	Relaxation meditation (Yoga Nidra), and during the resting state of normal consciousness	Cerebral blood flow distribution was investigated with the 15O-H20 PET technique	(H2)15O PET method may measure CBF distribution in the meditative state as well as during the resting state of normal consciousness, and that characteristic pattern of neural activity support each state

Newberg, Alavi, Baime, Pourdehnad, Santanna, d'Aquili (2001)	8	Experienced Tibetan Buddhist Meditators	Regional Cerebral Blood Flow (rCBF)	Increased rCBF was observed in the cingulate gyrus, inferior and orbital frontal cortex, dorsolateral prefrontal cortex (DLPFC), and the thalamus. The change in rCBF in the left DLPFC correlated negatively with that in the left superior parietal lobe. Correlation between the DLPFC and the superior parietal lobe may reflect an altered sense of space experienced during meditation.
Litscher, Wenzel, Niederwieser, Schwarz, (2001)	2	QiGong	Transcranial Doppler sonography, EEG, stimulus-induced 40 Hz oscillations, and near-infrared spectroscopy	Increase in mean blood flow velocity (vm) in the posterior cerebral artery, and a simultaneous decrease of vm in the middle cerebral artery)
Newberg, Pourdehnad, Alavi, d'Aquili, (2003)	3 Verbal meditators And 8 Buddhist meditators	"Verbal" based meditation by Franciscan nuns involving the internal repetition of a particular phrase compared with eight Buddhist meditators who use a type of "visualization" technique	SPECT: Regional cerebral blood flow	Mean verbal meditation scans showed increased blood flow in the prefrontal cortex, inferior parietal lobes, and inferior frontal lobes. There was a strong inverse correlation between the blood flow, change in the prefrontal cortex and in the ipsilateral superior parietal lobe
Khalsa, Amen, Hanks, Money, Newber (2009)	11 healthy individuals	Chanting Meditation	Single-photon emission computed tomography scans: Cerebral blood flow changes	Significant rCBF increases were observed in the right temporal lobe and posterior cingulate gyrus, and significant rCBF decreases were observed in the left parietotemporal and occipital gyri.

Cohen DL, Wintering N, Tolles V, Townsend RR, Farrar JT, Galantino ML, Newberg AB. (2009)	4 subjects	Cerebral blood flow before and after a 12-week training program in Iyengar yoga (IY) for novice subjects.	Singlephoton emission computed tomography scan (pre-program baseline).	There were significant decreases between the pre- and post program baseline scans in the right amygdala, dorsal medial cortex, and sensorimotor area. There was a significant difference in the pre- and postprogram percentage change (i.e., activation) in the right dorsal medial frontal lobe, prefrontal cortex, and right sensorimotor cortex.
Newberg, Wintering, Khalsa, Roggenkamp, Waldman, (2010)	14 with memory problems	8-week meditation program	Cognitive Function and Cerebral Blood Flow	Significant increases in baseline CBF ratios in the prefrontal, superior frontal, and superior parietal cortices. Scores on neuropsychological tests of verbal fluency, Trails B, and the logical memory showed improvements after training.
Newberg, Wintering, Waldman, Amen, Khalsa, Alavi, (2010)	12 advanced meditators and 14 non-meditators	Long-term Transcendental meditators	Cerebral blood flow (CBF) SPECT imaging	Significantly higher compared to non-meditators in the prefrontal cortex, parietal cortex, thalamus, putamen, caudate, and midbrain. There was also a significant difference in the thalamic laterality with long-term meditators having greater asymmetry.
Cheng, Borrett, Cheng, Kwan, Cheng, (2010)	15 meditators	Qigong meditation	Deoxyhemoglobin changes were recorded using near-infrared spectroscopy with a dual-wavelength probe	Decrease in Deoxyhemoglobin levels, suggesting an increase in Prefrontal activation during meditation. Decrease in Deoxyhemoglobin and increase in Oxyhemoglobin concentrations were observed in practitioners as compared with non-practitioners.

Wang, Rao, Korczykowski, Wintering, Pluta, Khalsa, Newberg, (2011)	10 experienced meditators	Two types of meditation, a "focused-based" practice and a "breath-based" practice	Pathwaysof meditation by addressing the cerebral blood flow (CBF) responses associated with two different meditation practices performed	The frontal regions, anterior cingulate, limbic system and parietal lobes were affected during meditation and that there were different patterns of CBF between the two meditation states. Strong correlations between depth of meditation and neural activity in the left inferior forebrain areas including the insula, inferior frontal cortex, and temporal pole.
Bhargav, Nagendra, Gangadhar, Nagarathna, (2014)	schiz ophrenia (n = 18; 14 males, 4 females) and (n = 18; 14 males, 4 females)	Kapalabhati (KB)	Frontal hemodynamic responses to high frequency yoga breathing technique using functional near-infrared spectroscopy	The increase in bilateral oxyHb and totalHb from the baseline was highly significant in healthy controls during KB. Schizophrenia patients showed significant reduction in deoxyHb in the right pre-frontal cortex.

Table 3: Meditation and Stroop Color Word Task

Author & Year of Publication	N	Design	Variable studied	Findings
Wenk-Sormaz (2005)	120	Meditation, rest, or a cognitive control	Stroop and Word Production (category generation and stem-completion)	Showed a reduction in habitual responding on the Stroop task as compared to controls. Meditation participants showed a reduction in habitual responding to the category production task.
Chan, Woollacott (2007)	50 meditators and 10 controls	Long-term trait effects of meditation	Stroop (measures executive attention) and Global-Local Letters (measures orientational attention) tasks	This suggests that meditation produces long-term increases in the efficiency of the executive attentional network (anterior cingulate/prefrontal cortex) but no effect on the orientation network (parietal systems)
Kozasa et al., (2012)	20 right-handed regular meditators and 19 non-meditators	"Zazen", Mantra Meditation, Mindfulnessof Breathing, Regular Meditators and Non-meditators	fMRI adapted Stroop Word-Color Task (SWCT), which requires attention and impulse control, using a block design paradigm	Non-meditators showed greater activity than meditators in the right medial frontal, middle temporal, precentral and postcentralgyri and the lentiform nucleus during the incongruent conditions. Non-meditators showed an increased pattern of brain activation relative to regular meditators under the same behavioral performance level.
Prakash et al., (2012)	20	Long-term Concentrative Meditation	The tests used were: (i) the Digit	Vihangam Yogis showed significantly better performances in all

			Span test, (ii) the Stroop Color Word test, (iii) the Trailmaking test, (iv) the Letter Cancellation Task, (v) the digit symbol substitution test, and (vi) the Rule Shift Card Test	these tests of attention except for the digit backward test, where a trend was found in favor of meditators. Long-term Vihangam Yoga meditators have superior cognitive abilities than non-meditators in the old age group.
Moore, Gruber, Derose, Malinowski (2012)	40	Mindfulness-based meditation	Computerized Stroop task while 64-channel EEG	Mindfulnessmeditation may alter the efficiency of allocating cognitive resources, leading to improved self-regulation of attention.
Teper R1, Inzlicht (2013)	44	Mindfulness Meditation	Error-related negativity (ERN),	Meditators showed greater executive control (i.e. fewer errors), a higher ERN and more emotional acceptance than controls..
Allen (2012)		Mindfulness Training (MT) on self-regulation	Measuredbehavioral metacognition and whole-brain BOLD signals using functional MRI during an affective Stroop task before and after	MT group displayed greater dorsolateral prefrontal cortex responses during executive processing, consistent with increased recruitment of top-down mechanisms to resolve conflict. MT practice showed improvements in response inhibition and increased recruitment of dorsal anterior cingulate cortex, medial prefrontal cortex, and right anterior insula during negative valence processing.
Bob et al., (2013)	7 healthy persons	Meditation	Bilateral electrodermal activity (EDA) and	The information transference (i.e., transinformation) is able to distinguish those attentional states, and that the

			attentional states (resting state, Stroop task, and memory task)	highest level of the transinformation has been found during attentional processing related to meditation, indicating higher level of connectivity between left and right sides.
Braboszcz, Cahn, Balakrishnan, Maturi, Grandchamp, Delorme (2013)	82 Isha yoga practitioners	Isha Yoga Meditation	Three behavioral psychophysical tests - a Stroop task, an attentional blink task, and a global-local letter task	Increase in correct responses specific to incongruent stimuli in the Stroop task, reduction of the attentional blink. A positive correlation between previous meditation experience and accuracy to incongruent Stroop stimuli was also observed at baseline.
Fan, Tang, Tang, Posner (2014)	43 UG students	Long term meditation practice	EEG and Stroop task	IBMT group showed decreased conflict reaction time (RT), and increased resting mean alpha power. Higher the enhancement of resting alpha power, the stronger the improvement of conflict RT. Shortterm meditation diffusely enhances alpha and improves the ability to deal with conflict and moreover, these two effects are positively related.

3.5. SUMMARY

This chapter presented the instrumentation used for investigations reported in this thesis (namely, EPI system), followed by available studies using EPI in clinical areas such as asthma and autism. The studies are not many; however, since EPI captures early onset of imbalances in subtle energies in organs, it is possible that this could provide an early warning as it were, for possible long term physiological effects in users of Mobile Phones. The chanter closes with a brief introduction to OM meditation and literature survey of relevant researches on meditation (Tables 2 and 3) which will be used in this thesis to possibly counter the effects of MPEMF effects.